DigLogs

Functional specification and Design details

5.2.3 App for data flows management

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Involved partners: All			
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Introduction: App for data flows management

As a part of DigLogs project, the Port of Rijeka Authority has decided to upgrade the existing maritime traffic control system to improve information system functionalities related to vessel traffic monitoring. This upgrade refers **both to upgrade of VTS/VTMIS system, but also extends newly derived services towards passengers as end users by means of a novel video feed service**, increasing the level of their satisfaction and passenger traffic safety.

In the following paragraphs, motivation for such a project, functional/technical analysis and their aspects are going to be explained in more details, to create a path towards project analysis and requirements specification later in the document.

1. Functional specification

Project goal is to establish a monitoring system using a highly modular, ready to go, compact surveillance solution using video and fixed lens thermal cameras, which is ideal for short to medium range surveillance applications to exactly pinpoint every small vessel or other vehicle Pilot project functions and scope

Main pilot function is provision of additional visibility layer to VTS system operators, increasing boat resolution and visibility, showing port basin situation to end stakeholders and passengers and enhancing safety in the area.

Scope of the pilot is requisitioning and purchase of the envisaged equipment, its installation and functional integration with the existing VTS system already in use in the Port control center of the Port of Rijeka Authority, and the visualization of the port panoramic presentation for the end user group of passengers using already existing visualization using Web page presentation.

Exact technical requirements, connectivity and input-output possibilities are subject to further determination during pilot development and component identification up to its end, as some components might change even during pilot execution. While main components are already identified as a part of analysis and requirements specification, it is possible that some smaller components will be identified later in the pilot execution, so flexibility will be required during later stages.

A required optical system must possess **adequate technical qualities to support envisaged role**. Among **initial and required parameters** that were discussed and considered are:

1. Vehicle (boat/maritime object) detection equal to or larger than length of Rijeka breakwater or other selected installation micro location (for example, passenger yachts quay),
2. Respect of industry Johnson criteria: vehicle size defined as 2,3 m2, detection at 2 pixels,

50% probability subject to environmental conditions,

3. Lens F number equal to 1.2 or better, in order to provide optimal sharpness of the image,
4. Resolution, at least 640x480,
5. Adequate camera controls and presentation mode,
6. FLIR capability, and
7. Pan–Tilt–Zoom controls, adding capability of remote directional and zoom controls.

Also, **connection with the system** using *Rijeka Traffic* application (business information system) already used in Rijeka Port Traffic Control center towering over passenger terminal is a prerequisite for successful pilot execution.

Video camera serving separate visual feed for display with Rijeka traffic business information system needs to have adequate quality, IP protection and to be weather and elements proof.

Pilot project limitations are primarily in form of focus on only passenger area, and not other port areas. Port of Rijeka has a quite diverse port structure, and full coverage would greatly exceed the budget and scope of the proposed pilot project.

Project assumptions are:

1. Time frame dedicated for pilot execution will be adequate,
2. Financial means for pilot requisitioning will suffice,
3. There are suitable locations for uninterrupted installation and operative usage of the video sensing equipment,
4. The stakeholders will be interested in the project deliverables (checked during WP4).

VTS is a service implemented by a Competent Authority, and in this case Port of Rijeka Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service has the capability to interact with the traffic and respond to traffic situations developing in the VTS area, as foreseen by the IMO Resolution A.857(20).

According to IALA VTS Recommendations when, considering the development and implementation of VTS, the Competent / VTS Authority need to decide on the type of service to be provided.

In this sense, VTS can be used as an Information Service, Traffic Organization Service and Navigational Assistance Service. This is shown in the Figure 1. on the next page.

Figure 1: Three modalities of VTS use

Information Service (INS) is a service to ensure that essential information becomes available in time for on board navigational decision-making.

1. The position, identity, intention and destination of vessels
2. Amendments and changes in information concerning the VTS area such as boundaries,

procedures, radio frequencies, reporting points
3. The mandatory reporting of vessel movements
4. Meteorological and hydrological conditions
5. Manoeuvrability limitations of vessels
6. Any information concerning the safety of navigation
7.

Traffic organization service (TOS) is a service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessel traffic within the declared VTS area.

- Planning or prioritizing of vessel movements to prevent congestion or dangerous situations
- Establishing of the system of traffic clearances
- Organizing of the allocation of space
- Following of special routes
- Observing of speed limits
- Observing a developing situation, interacting and coordinating of vessel traffic

NAS is a service that provides essential and timely navigational information to assist in the on board navigational decision-making process and to monitor its effects.

- Risk of grounding
- Risk of collision
- Vessel is deviating from the passage plan
- Vessel is unsure of its position
- Vessel is unsure of the route to its destination
- Assistance to anchoring
- Vessel defects or deficiencies
- Severe meteorological conditions

Objectives and benefits of the VTS system are:

- Vessel traffic management and safety provision in Improved quality of port services and resources utilization

- Greater safety of life and property
- Reduced risk associated with marine operations
- Detection of illegal activity
- Environmental protection
- Distribution of the VTS-related information to interested parties
- Storage of the VTS data for administrative purposes and incident analysis
- Provision of assistance in search and rescue operations and to the coastguard.

Current general configuration of the VTS system is shown in Figure 2 on the next page.
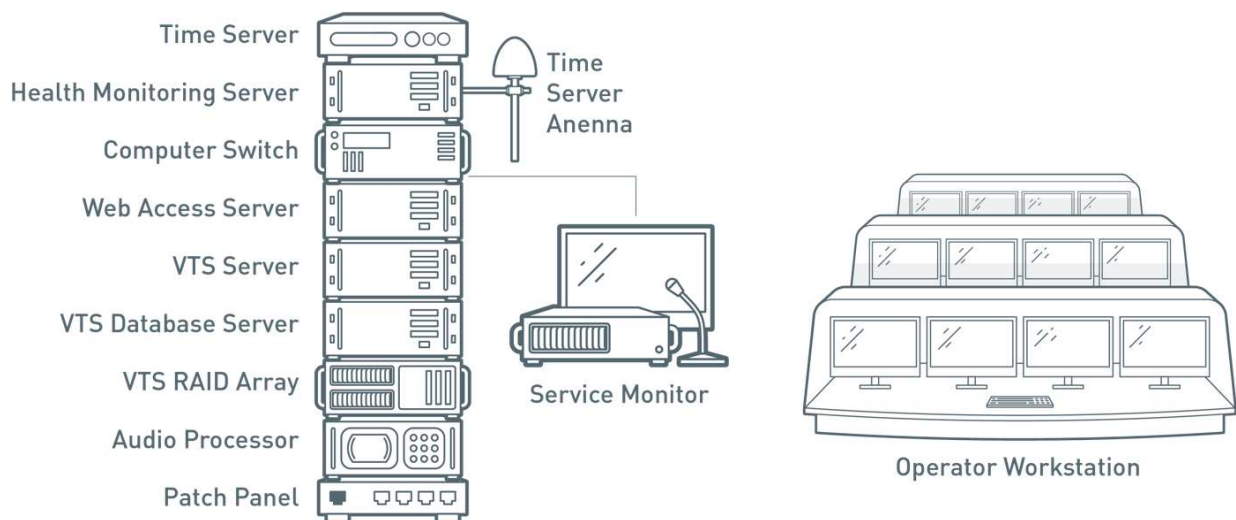
VTS Control Center configuration

Figure 2: Configuration of the VTS system

VTS server deployed as a part of the configuration is used for the following functionalities:

- Radar, AIS, CCTV, RDF, Meteo-Hydro sensors support and control
- Multi-Sensor Tracking and integration of targets
- Monitoring of traffic situation and generation of alarms and warnings
- Storage and sharing of the common system static data (VTS charts, sensor charts etc.)

- Continuous synchronous recording of VTS data
- Interface to export real-time tracked target data to the external users or systems via Ethernet TCP/IP protocol
- Support of redundant system configuration

Operator workstation has the following capabilities. However, it does not cover those functionalities that will be achieved as a part of the proposed project:

- Display and control of the electronic chart of coverage area
- Presentation of radar video over electronic chart
- Target data presentation and management
- Integrated AIS and radar video presentation
- Integrated VTS database client
- System configuration security
- Automatic CCTV camera tracking of a selected vessel
- Generation of alarms and notification messages
- Sensor remote control and diagnostic functionality
- Target simulation
- User plotted events displayed on all Operator consoles
- Password protected electronic chart editing capability

VTS system uses the following overlays, or overlay maps, as shown in Figure 3. on the next page.
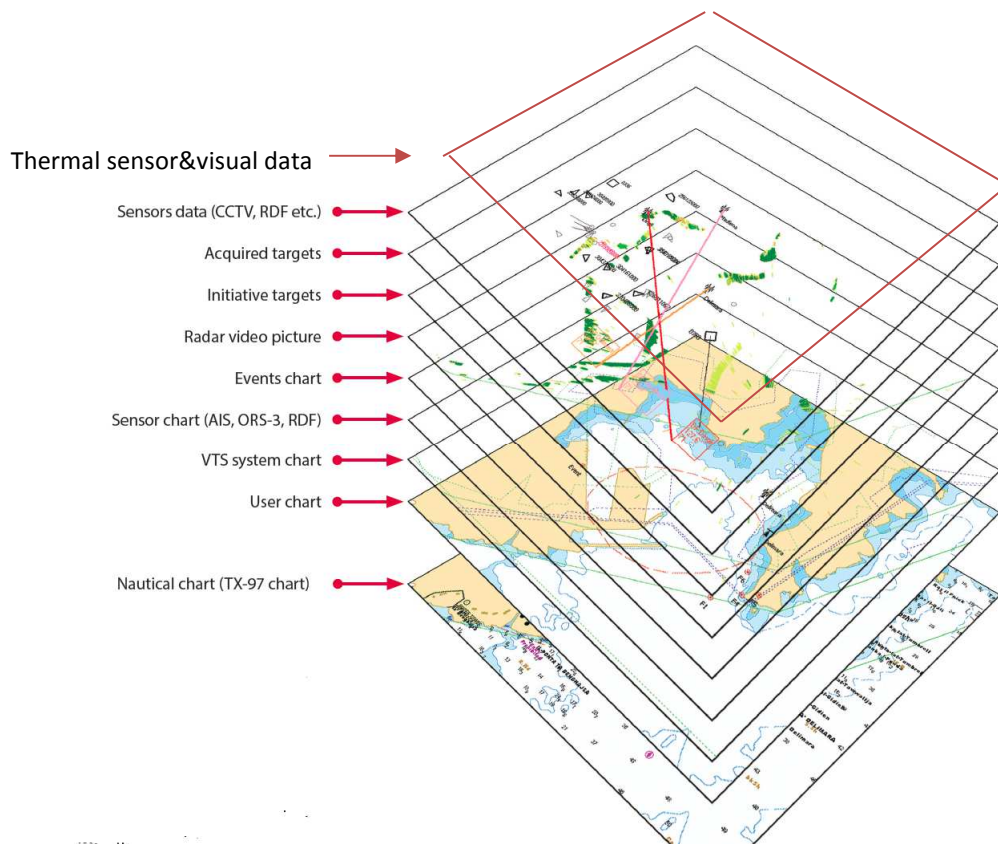
Figure 3: VTS overlays and added-value information

So, as shown in previous Figure 3, execution of the pilot project will directly benefit resolution and visibility of objects in the port, by including an additional level of increased resolution, as a direct consequence of the inclusion of new sensing hardware.

Oversight and integration with the Rijeka Traffic system in the segment of the visual feed, will be achieved by using a pair of varifocal IP67 IP cameras that will server the data feed using a dedicated switch for further processing and visualisation on the publicly available Web page towards end users (passengers). The idea is to present maritime traffic information in conjunction with other geospatial data and information to the end passengers.

A suitable candidate for the camera is, for example, manufactured by HIKVISION, DS-2CD2683G0-IZS, 8 MP IR Varifocal Bullet Network Camera.

This way, there will be twofold benefit for the end users – passengers – increased safety of maritime traffic on the VTS/VTMIS level, used by the Port Control Center, and the visualization of the area, on the passenger leve.

The intention is to create Web-based system for the end users in order to simplify the usage and avoid creation of two separate applications for mobile devices (Android and iPhone), that would not fit within the project's financial constraints.

2. Design details

A suitable candidate for the project core selected during preliminary research, and also as a part of previous WP packages, is The Oculus Scout. It is a highly modular, ready to go, compact surveillance solution using video and fixed lens thermal cameras which is ideal for short to medium range surveillance applications.

The Oculus is a compact, rugged, continuous rotation PTZ camera that has been specifically designed for marine, harsh and challenging environments. With a range of features such as the fixed lens uncooled thermal cameras and low light HD 30:1 zoom day/night video camera make the Oculus Scout a versatile and cost effective solution.

A wide range of thermal and video cameras are available for the Oculus, all supplied in cable managed housings for protection in the harshest environments. With belt driven gears as standard the Oculus has virtually zero backlash ensuring the capture of stable images even at very long distances over land or water.

All Silent Sentinel Pan and Tilt systems are designed with absolute positing feedback as standard. So when twinned with radar or any automated control program it can be driven automatically to any threat detected and remain on target as the threat moves. As with all Silent Sentinel products the Oculus can easily be deployed as a standalone system or a combined solution to increase the performance.

The fact that Oculus platform can be configured and optimized for a broad range of applications and operational theatres with the ability to detect, identify, track and react to the surveillance requirement was crucial in order to be selected as a primary candidate for the pilot project.

Key features (capability demonstration shown in Figure 4. on the right side)

- Supporting ranges up to 2.6km for human detection and 3.4km for vehicle detection.
- Short to medium range fixed lens thermal cameras (up to 50mm).
- Starvis HD Colour camera.
- Thermal camera 'Image Contrast Enhancement' (ICE^{TM}).
- Multiple thermal colour palettes.
- Focal length dependent speed control (zoom).
- Anti fog, anti haze and image stabilisation capabilities.
- Absolute positioning feedback for radar control.
- 360° continuous rotation.
- High performing pan and tilt speeds up to 180° per second.
- Virtually zero backlash with automatic self position correction.
- Optical encoders for preset accuracy (0.05° repeatability).
- Compact housings with wipers as standard*.
- ONVIF Profile S compliant.
- Highly ruggedized for extreme and marine environments.
- IP67, REACH, ROHS & CE Compliant.

Figure 4: Symbolic demonstration of capabilities

Optional capabilities include:
- Image Fusion, Image Stabilization,
- 2 Axis Gyro Stabilisation,
- Automatic Object Tracking,
- Heaters,
- Various Mounting Options,
- Stainless Steel Finish,
- Custom Paint Colours,
- Bird Spikes, and Sunshields.

Figure 5: Oculus Scout system

The Silent Sentinel short to medium range uncooled thermal fixed lens camera modules are designed to provide the perfect value added video surveillance solution when integrated into the compact Oculus PT platform. Specifications are shown in Table 1. below.

Lens			
Focal Length	**14mm**	**35mm**	**50mm**
Optical Zoom (Continuous)	-	-	-
F Number	F1.4	F1.2	F1.2
Horizontal Field of View	44°	17.6°	12.4°
Focus	Fixed, preset with Athermalization		

Camera	
Detector Type	Uncooled VOx Microbolometer
Resolution	640 x 480
Pixel Size	17 µm
Spectral Band	8 to 14 µm (LWIR)
Sensitivity	< 50 mK (NEdT) f/1.0 @ room temperature
Frame Rate	25 Fps (9 fps, 30fps options)
Frequency	25Hz (9Hz, 30Hz options)
Digital Zoom and Pan	4x Digital zoom, Region of
Digital Video	Interest 14/8-bit
Video Output	LVCMOS/Camera Link®
Window	IP and Composite (PAL / NTSC)
	Germanium thermal optical quality glass, with a low reflection coating
Image Stabilisation	Yes (cost option)
Image Enhancement	Image Contrast Enhancement (ICE™)
Image Control	Polarity: White Hot / Black Hot, Orientation: Invert / Revert

Detection, Recognition and Identification Ranges (Johnsons Criteria*)			
Detection (Human / Vehicle)	740m / 950m	1850m / 2370m	2650m / 3390m
Recognition (Human / Vehicle)	190m / 240m	460m / 580m	660m / 850m
Identification (Human / Vehic	110m / 150m	285m / 360m	410m / 520m
Human at 1.8m x 0.75m, vehic 2.3	m², Detection at 2	8 pixels and Identification at 13 pixels.	

The Silent Sentinel short to medium range HD video camera module is designed to provide streamlined surveillance solution when integrated into the compact Oculus PT platform.

Table 1: Oculus PT specifications

It features superb low light H   saving bandwidth), intelligent auto exposure and auto focus to enable a crisp image at range.

Specifications are shown in Table 2 below.

Lens	
Focal Length	**4.3mm to 129mm**
Optical Zoom (Continuous)	30x, Motorised
F Number	F1.6 to F4.7
Horizontal Field of View	63.7° (W) to 2.32° (T)
Format Size	1/2.8"
Focus	Auto focus and motorised manual focus
Iris	Auto iris
Camera	
Sensor	1/2.8" CMOS Exmor (2.13MP)
Sensor Mode	Full HD 1080p (1920 x 1080) **HD**
Wide Dynamic Range	Yes (120 dB)
Video Performance (High Sensitivity Mode)	Colour 0.01 lux Mono 0.0008lux
White Balance	Auto, push and manual
Automatic Level Control (ALC)	Auto / manual
Shutter	1/1 s to 1/10,000
Day/Night Mode	Auto, colour, monochrome
Backlight Compensation	On / off
Noise Reduction	Yes
Digital Zoom	12x (360x combined)
Video Output (PAL / NTSC)	IP (HD-SDI option)
Window	High Definition optical quality glass, with a low reflection and water resistant coating
Defog	Yes
Image Stabilisation	Yes

Table 2: Technical specifications of Video Camera Module

The compact aluminum housing is rated to IP67, it is hard anodized and has a white marine grade paint to withstand harsh environmental and marine conditions. The Oculus employs belt drives with virtually zero backlash and the optical encoder ensures the unit retains position and will even self correct.

Electrical and Mechanical

Camera Construction	Die-cast hard anodised aluminium with A4 stainless fittings
Repeatability	0.05°
Optical Encoder Preset Accuracy	0.01°
Pan Rotation	360° Continuous
Pan Speed	180° per second (excluding ramping)
Tilt Range	+90° to -30° upright (-68° inclined), +30° to -90° inverted
Tilt Speed	180° per second (excluding ramping)
Speed Control	Zoom dependant speed control
Position Control	Capable of retraining position without drift. Automatic position recovery if forced away by a 'non-control' intervention
Motor Drive	Long life toothed polypropylene belt drive, Pulleys bonded to keypad shafts for minimum backlash
Rotational Contacts	Heavy duty slip rings for power, data, video and switching for washer
Pan / Tilt Bearings	Sealed for life – no maintenance required
Actuation	Pan and tilt stepper motors
Position Encoders	Optical encoders on pan and tilt motors
Mounting Profile	Upright or inverted
IP rating	IP67
Temperature Range	-20°C (-4°F) **Up to 65°C (1**49°F) (-40°C with optional heater)
Power	14 to 36vDC or 14 to 26vAC, 45W peak (100W with optional heater) (20W typical in low power mode when idle without heater)
Fixing Material	Stainless steel with external fall protection
Housing Finish	White powder marine grade paint finish (other colours are available upon request)
Weight	7kg (15.43lb)
Turning Diameter	220mm / 8.66" Normal - 370mm / 14.57" Offset
Height	370mm / 14.57" Normal - 340mm / 13.86" Offset

Telemetry

Presets	127x Preset positions, 16x preset tours (maximum of 60 positions each), four 8 minute mimic tours
Protocols	Pelco-D, Pelco P, Pelco D Extended, CBC OCP485, Forward Vision Mic1 FV300, Philips, Vicon, SSP, ONVIF Profile-S
Parameter Programming	IP, RS485 (not IP)
Privacy Zones	Maximum of eight on-screen simultaneously
Positioning	Absolute positioning
Additional features	Programmable text within picture (camera ID), parameter control (RS232 or RS485) TCP/IP prepared, compass heading (cardinal point and/or degrees), focal length dependant pan and tilt control, in built real time clock and date

Table 3: Electrical and Mechanical specifications of Oculus Compact

Other features and options of the system are shown in table 4. below.

Image Processing	
Video Compression	H.264/MPEG4 Part 2, M-JPEG
H.264 Performance (Standard)	Total D1 at 390 fps or Full HD 1080p at 65 fps Examples: 2x 1080p at 30 fps (HD video/thermal) or 2x D1 at 30 fps (thermal / SD)
Image Processing	Image resizing and scaling ratio, noise reduction, edge enhancement (sharpness), ROI based video compression
Software Update	Remote / IP accessible
Other Features	Email Notifications, Text Overlay
Options	
Brackets	Tower mount, pole mount, 1m pendant mount, wall mount, corner mount, swan neck mount, heritage mounts
Wiping	Wiper nozzle and wash tank (for the video camera only)
Gyro	2 Axis gyro stabiliser
Image Fusion	Thermal and video Image Fusion with stepped preset zoom
Analogue	Analogue composite camera alternatives are available upon request
Storage	Up to 64GB in total via SD/MMC (32GB available per channel if using thermal and video / 2x cameras)
Additional Optional Modules	Bird Spike, Sunshield, Automatic Object Tracking, Image Stabilisation, Heater, Satin Stainless Steel Housing, Custom Paint Colours Please contact us if you have a specific requirement that is not mentioned or detailed in the part numbers
RC3-SCOUT-50-W	Oculus Scout – with a 640x480, 50mm fixed lens thermal camera and a HD video camera with optical zoom of 30x, white colour
Options	All cable, ancillary and optional part numbers are available upon request

Table 4: Image processing and options

Key features of the varifocal camera are shown as follows:

1. BLC/3D DNR/ROI/HLC
2. IP67, IK10
3. Built-in micro SD/SDHC/SDXC card slot, up to 128 GB

4. 1/2.5" Progressive Scan CMOS

5. 3840 × 2160 @15 fps

6. 2.8 to 12 mm varifocal lens

7. Color: 0.01 Lux @ (F1.2, AGC ON), 0.018 Lux @ (F1.6, AGC ON), 0 Lux with IR

8. H.265+, H.265, H.264+, H.264

9. 2 Behavior analyses

10. 120dB WDR

11. BLC/3D DNR/ROI/HLC

12. IP67, IK10

13. Built-in micro SD/SDHC/SDXC card slot, up to 128 GB

Full specifications of the camera are shown as follows.

Specifications

Camera	
Image Sensor	1/2.5" Progressive Scan CMOS
Min. Illumination	Color: 0.01 Lux @ (F1.2, AGC ON), 0.018 Lux @ (F1.6, AGC ON), 0 Lux with IR
Shutter Speed	1/3 s to 1/100,000 s
Slow Shutter	Yes
Auto-Iris	No
Day & Night	IR Cut Filter
Digital Noise Reduction	3D DNR
WDR	120dB
3-Axis Adjustment	Pan: 0° to 355°, tilt: 0° to 90°, rotate: 0° to 355°
Lens	
Focal Length	2.8 to 12 mm
Lens Type	Motorized
Aperture	F1.6
Focus	Auto
FOV	Horizontal field of view: 105° to 34.5° Vertical field of view: 55° to 19° Diagonal field of view: 125° to 40°
Lens Mount	Φ14
IR	
IR Range	Up to 50 m
Wavelength	850nm
Compression Standard	
Video Compression	Main stream: H.265/H.264 Sub-stream: H.265/H.264/MJPEG Third stream: H.265/H.264

H.264 Type	Main Profile/High Profile
H.264+	Main stream supports
H.265 Type	Main Profile
H.265+	Main stream supports
Video Bit Rate	32 Kbps to 16 Mbps
Audio Compression	G.711/G.722.1/G.726/MP2L2/PCM
Audio Bit Rate	64Kbps(G.711)/16Kbps(G.722.1)/16Kbps(G.726)/32-192Kbps(MP2L2)
Smart Feature-set	
Behavior Analysis	Line crossing detection, intrusion detection
Face Detection	Yes
Region of Interest	Support 1 fixed region for main stream and sub-stream
Image	
Max. Resolution	3840 × 2160
Main Stream	50Hz: 12.5 fps (3840 × 2160), 20fps (3072 × 1728), 25 fps (2560 × 1440, 1920 × 1080, 1280 × 720) 60Hz: 15 fps (3840 × 2160), 20fps (3072 × 1728), 30 fps (2560 × 1440, 1920 × 1080, 1280 × 720)
Sub-Stream	50Hz: 25fps (640 × 480, 640 × 360, 320 × 240) 60Hz: 30fps (640 × 480, 640 × 360, 320 × 240)
Third Stream	50Hz: 25fps (1280 ×720, 640 × 360, 352 × 288)